INVESTIGATION OF PARTICULATE LEVELS, IN AIR, IN THE CHARL[illegible]OD AREA OF WINNIPEG

Manitoba
Environment
and Workplace
Safety and Health

INVESTIGATION OF PARTICULATE LEVELS, IN AIR, IN THE CHARLESWOOD AREA OF WINNIPEG

by Special Studies Program

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ABSTRACT

In response to citizen concerns of road dust contributing to the degradation of air quality in the Charleswood area of Winnipeg, the Environmental Management Division, at the request of the Department of Urban Affairs, undertook an air monitoring program to measure total suspended particulate (TSP) or dust levels.

Air sampling using the standard high volume air sampler was conducted at three sites (C1, C2 & C3)in the Charleswood area during the period of June to August, 1983. Station C3 was established after sampling at C1 was discontinued. Background sampling in other areas of the city was performed concurrently.

Dust levels in the Charleswood area prior to road repairs were significantly elevated and often in excess of Air Quality Objectives. Approximately one-half of the samples collected at one site (C2) exceeded the Maximum Tolerable Level (MTL) of 400 micrograms of particulate per cubic meter ($\mu g/m^3$) of air as a 24-hour average. The magnitude of these levels indicated a situation in need of immediate attention. All of the samples at a second site (C3), though mostly below the MTL, exceeded the 24-hour Maximum Acceptable Level (MAL) of 120 $\mu g/m^3$. Site C1, through abbreviated sampling, had lower dust levels with approximately one-third exceeding the MAL.

After road repairs including application of surface oil, dust levels dropped appreciably to concentrations similar to background (below MAL).

Bennett, N., 1984, Investigation of Particulate Levels, in air, in the Charlewood Area of Winnipeg, Department of Environment and Workplace Safety and Health, Air Standards and Studies Section, Report No. 69-1, pp. 24.

ABSTRACT

In response to citizen concerns of road dust contributing to the degradation of air quality in the Charlewood area of Winnipeg, the Environmental Management Division, at the request of the Department of Urban Affairs, undertook an air monitoring program to measure total suspended particulate (TSP) or dust levels.

Air sampling using the standard high volume air sampler was conducted at three sites (C1, C2 & C3)in the Charlewood area during the period of June to August, 1983. Station C1 was established after sampling at C1 was discontinued. Background sampling in other areas of the city was performed concurrently.

Dust levels in the Charlewood area prior to road repairs were significantly elevated and often in excess of Air Quality Objectives. Approximately one-half of the samples collected at one site (C2) exceeded the Maximum Tolerable Level (MTL) of 400 micrograms of particulate per cubic metre (ug/m^3) of air as a 24-hour average. The magnitude of these levels indicated a situation in need of immediate attention. All of the samples at a second site (C3), though mostly below the MTL, exceeded the 24-hour Maximum Acceptable Level (MAL) of 150 ug/m^3. Site C1, through abbreviated sampling, had lower dust levels with approximately one-third exceeding the MAL.

After road repairs including application of surface oil, dust levels dropped appreciably to concentrations similar to background (below MAL).

For the duration of the study, levels at the background sites were below the 24-hour MAL objectives (with one exception). Levels during this study were consistent with historical data from these background stations thus representing a normal or expected reading.

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1. BACKGROUND

As a result of complaints regarding ambient dust-in-air levels, the Charleswood Homeowners' Association (CHA) requested, through the Department of Urban Affairs, that the Environmental Management Division monitor dust levels in the Charleswood area. The concerns of the CHA were that elevated dust levels along certain streets were a regular occurrence and were contributing to a potential health and/or safety risk. It was the suggestion of the CHA that dust was being produced from unpaved roadways by vehicular entrainment of surface materials.

Charleswood is primarily a residential area located in the southwest portion of the City of Winnipeg. Its borders are defined by the Assiniboine River to the north, Wilkes Avenue to the south, Charleswood Road to the west and Chalfont Road to the east. Part of this area consists of unpaved streets which are surfaced with packed gravel. Through the years it has been the option of homeowners to accept this type of roadway. However, the degree of maintenance and measures to reduce dust levels became grounds for a dispute between homeowners and the City administration in 1983, when complaints of elevated dust levels were voiced by homeowners in the affected areas.

Total suspended particulate (TSP), or dust, is defined as particles of either solid or liquid phase existing in a size and configuration which permits them to remain suspended in the ambient air. The major contributors or causes of TSP levels within urban areas are from industrial emissions, secondary particulate formation (smog), background agricultural wind borne dust, and vehicular entrainment of street dust.

Other studies have shown that in some areas unpaved roads can be the largest source of particulate emissions[1] and also that within the category of open area sources, (i.e. those sources too great in extent to control through enclosure or ducting...), only unpaved roads appear to contribute significantly to measured TSP levels.[2]

Particulate levels have been measured at urban and rural sites in Manitoba since 1970. This monitoring is performed as part of the National Air Pollution Surveillance (NAPS) program. Other monitoring has been undertaken within the vicinity of certain industrial or area sources where a source to receptor relationship was investigated.[3] A roadway study (similar to that reported in this study) was conducted in 1982 in the McIvor Avenue area of Winnipeg.[4] That study, an investigation of air quality (dust levels), was prompted by citizen concerns.

Background levels of particulate can vary significantly depending upon the site of measurement.[5] Levels measured at a rural site near Winnipeg, St. Francois Xavier, have annual averages about 25 $\mu g/m^3$ though individual 24-hour readings have been as high as 250-500 $\mu g/m^3$ (refer to Appendix #1). Levels within a residential area of Winnipeg (Scotia and Jefferson, NAPS #70118) have averaged annually in the range of 35-40 $\mu g/m^3$. Individual 24-hour readings have, on occasion, reached levels well beyond the MTL.[5 & 6]

This report summarizes ambient particulate levels measured along unpaved roadways in the Charleswood area of Winnipeg during the period June to August, 1983. Specific objectives of the study were:

1) To determine suspended particulate levels in the vicinity of specific unpaved streets where citizen concerns existed.
2) To compare measured particulate levels to Manitoba and National Air Quality Objectives.
3) To compare measured levels to results from other areas of the city during the same period.

While it was not a specific objective of the study to undertake extensive sampling after road repairs were completed, some sampling was performed. This permitted observations regarding the effect of repairs on dust levels.

2. AIR QUALITY OBJECTIVES

Manitoba Air Quality Objectives and Guidelines have been formulated for various air pollutants. The objectives for TSP (Table 1) have been adopted from the National Ambient Air Quality Objectives. These Provincial criteria have been established about two levels:

Maximum Acceptable Level (MAL) - This level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being.

Maximum Desirable Level (MDL) - This level defines long term goals for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of the Province and for the continuing development of control technology.

Additionally, the National Air Quality Objectives consider a third level of assessment, the Maximum Tolerable Level (MTL). This criteria level denotes time-based (24-hour) concentrations of air contaminants beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population. The MTL for TSP is currently under review by a national committee.

Particulate material is the most commonly perceived form of pollution, often manifesting itself by interference with visibility, a soiling effect on materials, or as a respiratory irritant.

The maximum acceptable levels[7] have been designed to prevent undue visibility reduction (visibility reduced below 8 kilometers when particulate exceeds 100 $\mu g/m^3$) and to minimize respiratory effects.

7 AIR QUALITY OBJECTIVES

The maximum desirable levels[7] have been justified on the basis of being similar to background values and at the range where a social awareness of particulate pollution arises.

The maximum tolerable levels[7] are based on studies which have shown that health effects can arise when particulate levels alone prevail at the criteria concentration.

TABLE 1 Criteria Levels for Total Suspended Particulate (TSP)

AVERAGING PERIOD	MAX. DESIRABLE LEVEL (MDL)	MAX. ACCEPTABLE LEVEL (MAL)	MAX. TOLERABLE LEVEL (MTL)
Manitoba Air Quality Objectives:			
24-hour	-	120	-
Annual Geom. Mean	60	70	-
National Air Quality Objective:			
24-hour	-	0-120	120-400
Annual Geom. Mean	0-60	60-70	-

Concentrations levels are expressed in units of micrograms of TSP per cubic meter of air ($\mu g/m^3$) corrected to standard conditions of $25^{o}C$ and 101.3 kilopascals of pressure.

3. PROCEDURES

Sampling for total suspended particulate (TSP) was performed in accordance with the Environment Canada reference method, "Standard Reference Method for the Measurement of Suspended Particulate in the Atmosphere (High Volume Method)", EPS Report No. 1-AP-73-2 (January, 1973).

In summary, the procedure consists of drawing air at an average flowrate of between 1.13 to 1.70 cubic metres per minute through a glass fibre filter paper (Gelman type A/E) for a period of 24 hours. This filter, 406 cm^2 in area (approx. 20 x 25.5 cm) located on the intake side of an air pump, entraps particulate in a size range from 0.3 μm in diameter (at a 99% efficiency rate) up to 100 μm in diameter. Pre-weighed filters are weighed after exposure to determine the mass of particulate collected. The concentration in air (of TSP) is calculated by dividing the mass by the total volume of air sampled. Total air volume is recorded on a flow transducer chart.

Preparation and analysis of filters was carried out at the W. M. Ward Technical Services Laboratory using prescribed methodology.

At each Charleswood site samplers were set up in duplicate to allow for calendar day-to-day sampling. Sampling was conducted from midnight to midnight, for a 24-hour period, by using external timing devices.

The high volume samplers were calibrated with an orifice kit prior to the start of the survey. Rigid operational standards were adhered to in order to ensure the collection of valid data.

4. MONITORING SITES

Sampling sites were chosen at locations where complaints were voiced and where residents were willing to accommodate the placement of monitoring equipment. Sites were chosen on well travelled gravel roads.

Three sites were used within the Charleswood area (Map 1), although sampling was only conducted at any two simultaneously (i.e. C3 commenced after C1 was termined). The locations of the sites were:

1) Site C1 - 765 Elmhurst Road in the front yard (Map 2).
2) Site C2 - 767 Charleswood Road in the front yard (Map 3).
3) Site C3 - 627 Pepperloaf Crescent in the front yard (Map 4).

Samplers were placed at ground level in the best available location in each yard and were situated approximately 8 metres from the road. At each site there were no restricting objects between the samplers and the road.

Background sites were at the following National Air Pollution Surveillance (NAPS) locations.

1. NAPS 70118 - 299 Scotia Street, Winnipeg, regarded as representative of an urban residential environment.
2. NAPS 70119 - 65 Ellen Street, Winnipeg, regarded as representative of an urban downtown environment.

4. MONITORING SITES

Sampling sites were chosen at locations where complaints were voiced and where residents were willing to accommodate the placement of monitoring equipment. Sites were chosen on well travelled gravel roads.

Three sites were used within the Charleswood area (Map 1).

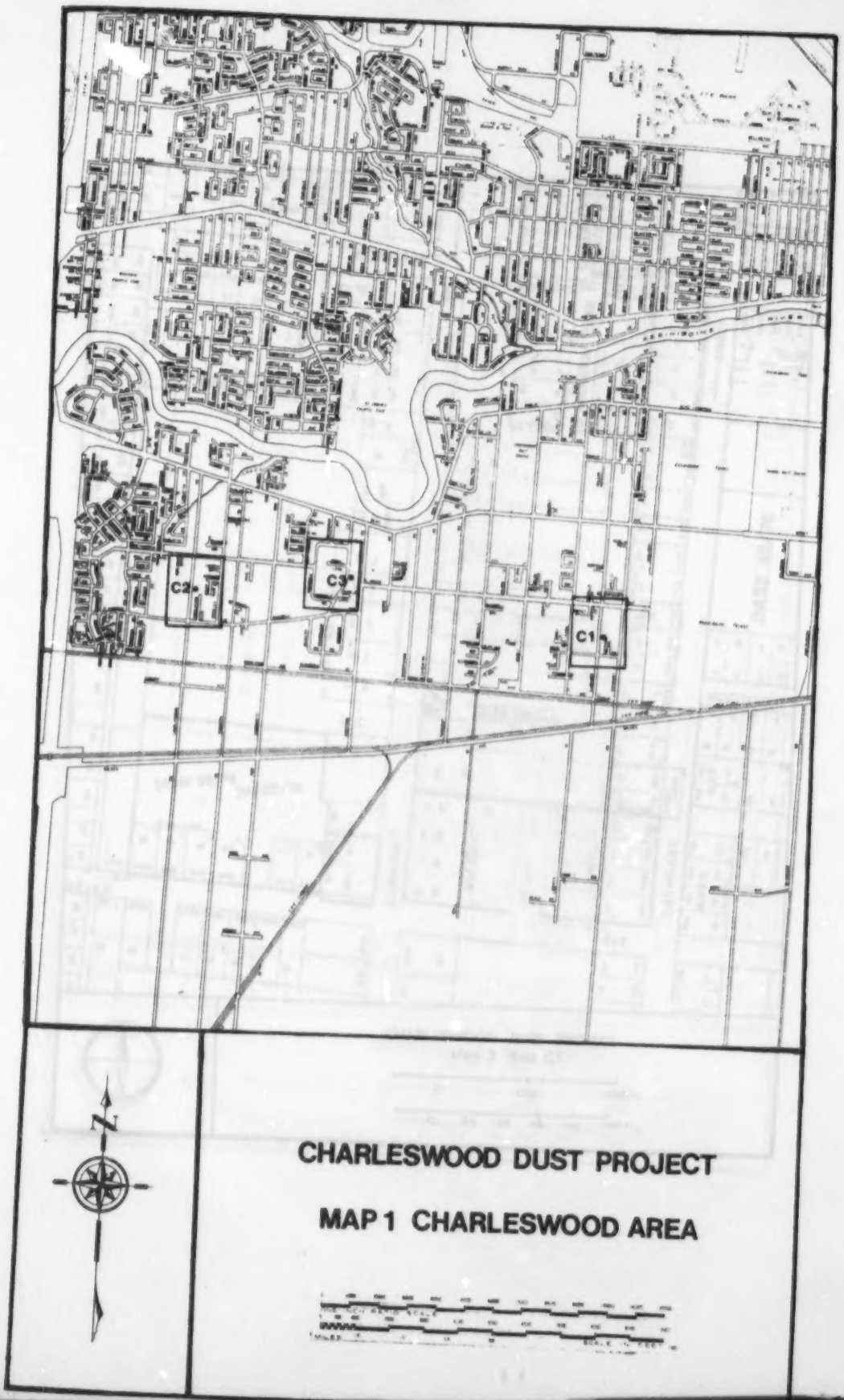
Although sampling was only conducted at any two simultaneously (i.e. C3 commenced after C2 was terminated). The locations of the sites were:

1) Site C2 - 765 Elmhurst Road in the front yard (Map 2).
2) Site C3 - 745 Charleswood Road in the front yard (Map 3).
3) Site C1 - 627 Poppyleaf Crescent in the front yard (Map 4).

Samplers were placed at ground level in the most available location in each yard and were situated approximately 6 metres from the road. At each site there were no restricting objects between the samplers and the road.

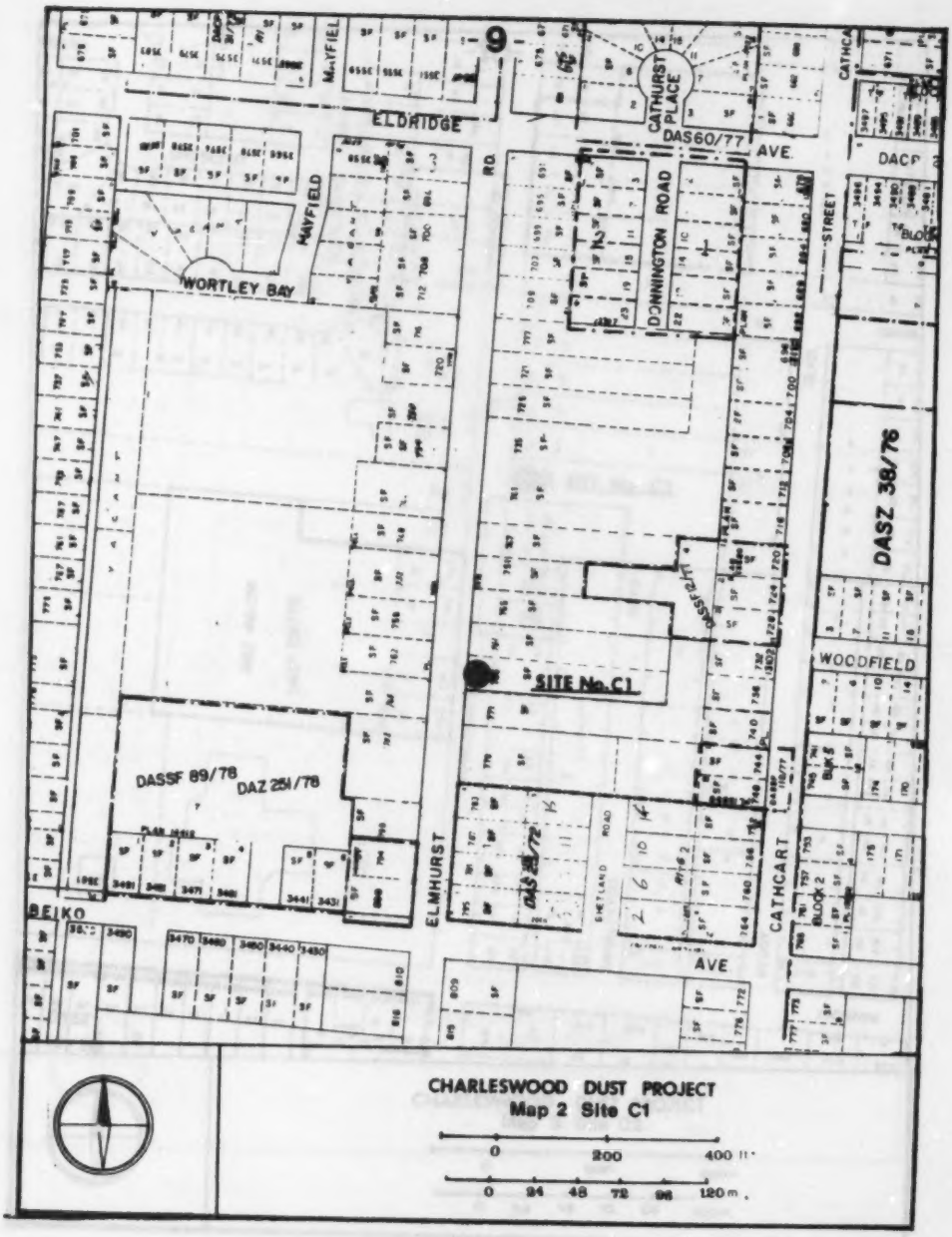
Background sites were at the following National Air Pollution Surveillance (NAPS) locations:

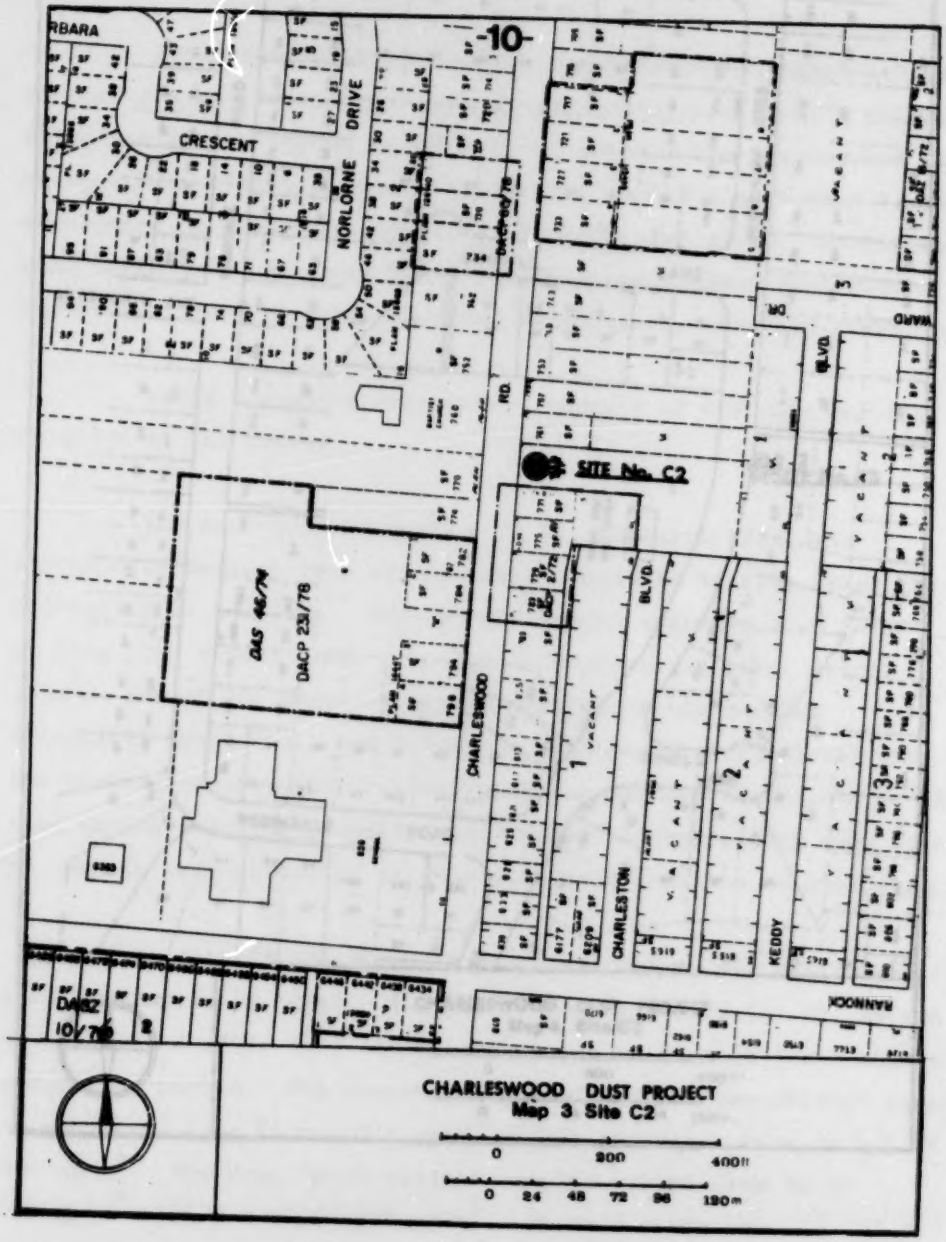
1. NAPS 70119 - 299 Bourke Street, Winnipeg, regarded as representative of an urban residential environment.
2. NAPS 70119 - 65 Ellen Street, Winnipeg, regarded as representative of an urban downtown environment.

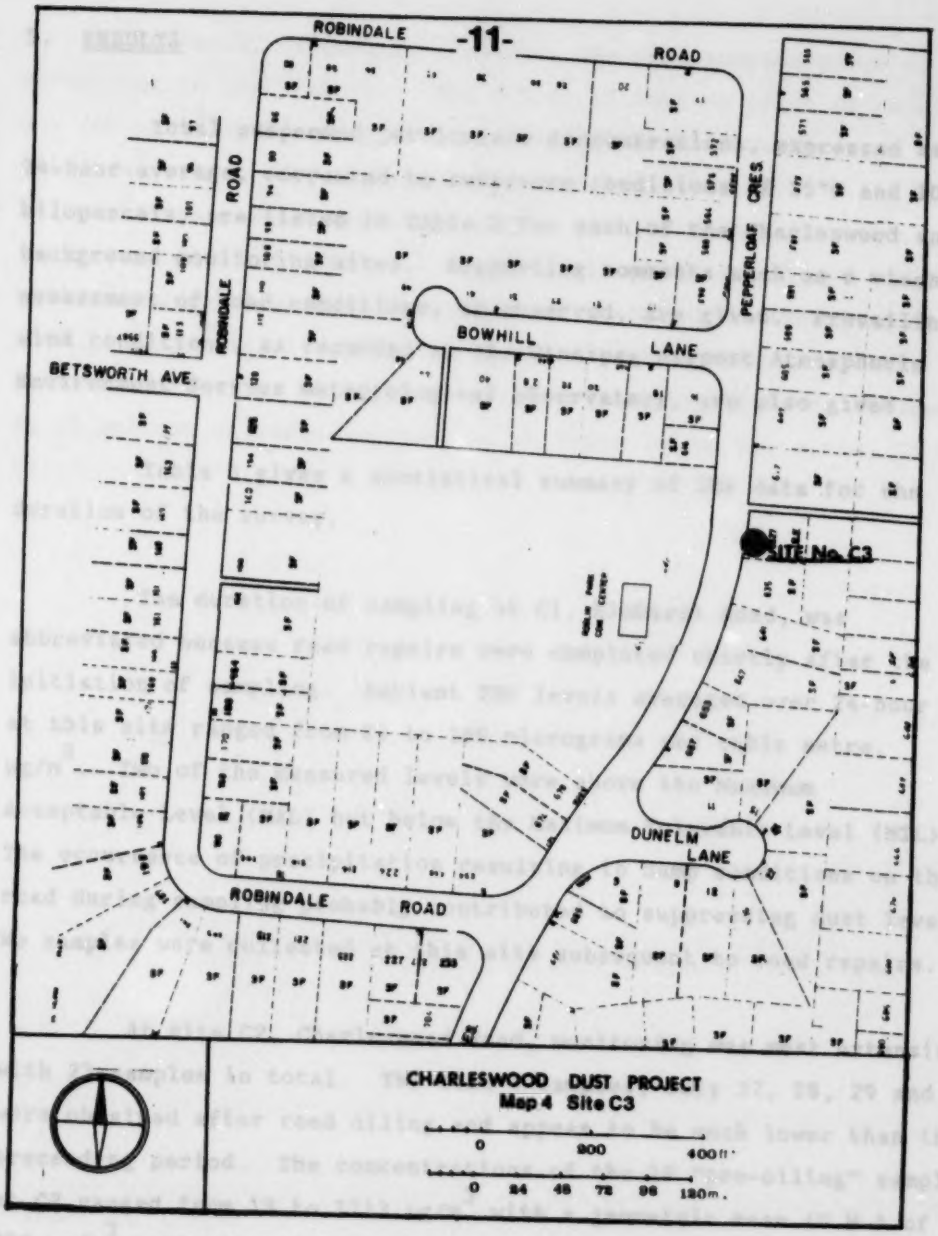


CHARLESWOOD DUST PROJECT

MAP 1 CHARLESWOOD AREA


ELDRIDGE RD.
CATHURST PLACE
DAS60/77
AVE.
DONNINGTON ROAD
STREET
WORTLEY BAY
DASZ 38/76
SITE No.C1
WOODFIELD
DASSF 89/76
DAZ 251/76
ELMHURST
CATHCART
AVE
BEIKO
CHARLESWOOD DUST PROJECT
Map 2 Site C1
0
200
400 ft
0
24
48
72
96
120 m.


-10-
CRESCENT
NORLORNE DRIVE
SITE No. C2
DAS 46/74
DACP 231/78
CHARLESWOOD RD
CHARLESTON BLVD.
KEDDY BLVD.
VACANT
RANNOCK
CHARLESWOOD DUST PROJECT
Map 3 Site C2
0 200 400ft
0 24 48 72 96 120m


ROBINDALE ROAD
ROBINDALE ROAD
PEPPERLOAF CRES.
BOWHILL LANE
BETSWORTH AVE.
SITE No. C3
DUNELM LANE
ROBINDALE ROAD
CHARLESWOOD DUST PROJECT
Map 4 Site C3
0 200 400ft.
0 24 48 72 96 120m.

5. RESULTS

Total suspended particulate concentrations, expressed as a 24-hour average, corrected to reference conditions of 25°C and 101.3 kilopascals, are listed in Table 2 for each of the Charleswood and background monitoring sites. Supporting comments such as a visual assessment of road conditions, as observed, are given. Prevailing wind conditions, as recorded at the Winnipeg Airport Atmospheric Environment Service meteorological observatory, are also given.

Table 3 gives a statistical summary of TSP data for the duration of the survey.

The duration of sampling at C1, Elmhurst Road, was abbreviated because road repairs were completed shortly after the initiation of sampling. Ambient TSP levels averaged over 24-hour at this site ranged from 23 to 169 micrograms per cubic metre, $\mu g/m^3$. Two of the measured levels were above the Maximum Acceptable Level (MAL) but below the Maximum Tolerable Level (MTL). The occurrence of precipitation resulting in damp conditions on the road during sampling probably contributed to suppressing dust levels. No samples were collected at this site subsequent to road repairs.

At site C2, Charleswood Road, monitoring was most extensive with 23 samples in total. The last 4 samples, July 27, 28, 29 and 31 were obtained after road oiling and appear to be much lower than the preceeding period. The concentrations of the 19 "pre-oiling" samples at C2 ranged from 19 to 1213 $\mu g/m^3$ with a geometric mean (G.M.) of 252 $\mu g/m^3$. The four "post-oiling" samples varied from 96 to 237 $\mu g/m^3$ with a G.M. of 150 $\mu g/m^3$. In this study the measurements of highest magnitude were obtained at this site. The concentrations of nine individual samples exceeded the MTL.

Site C3, Pepperloaf Crescent, was also sampled prior to and subsequent to road repairs. The G.M.of 13 samples prior to repairs was 269 $\mu g/m^3$ with concentrations ranging between 146 to 512 $\mu g/m^3$. Post road repair samples (3) had a G.M. of 94 $\mu g/m^3$ with a range of 92-95 $\mu g/m^3$. One of the "pre-oiling" samples exceeded the MTL. In excluding the 3 "post-oiling" samples; the percentage of samples exceeding the 24-hour MAL rises from 81 to 100%. Similar to C2, at this site a decrease of dust levels was observed after road oiling. It was also observed that the air quality at C1 was not as badly degraded as at these latter two sites, C2 and C3.

TABLE 2. Total Suspended Particulate (TSP), in Air, Concentrations
Charleswood Area Study

Sampling Date	Prevailing Wind (Dir. SP.)	Visual Road Condition	Sampling Sites C1	C2	C3	70118	70119	Comments
83-06-29	SE 13	dry	156	61	-	47	89	
-30	NW 8	wet	23	28	-	-	-	Rain
07-02	ESE 16	wet	33	19	-	17	46	Rain
-05	S 14	damp	169	114	-	28	62	
-06	S 21	damp	99	102	-	-	-	
-07	SSE 12	dry	110	457	-	78	125	
-08	NNE 12	dry	84	212	-	-	-	*1 see below
-11	SW 28	dry	-	583	-	80	106	
-12	S 16	dry	-	490	453	-	-	Start Pepperloaf (C3)
-13	S 13	dry	-	832	485	-	-	
-14	ESE 12	dry	-	144	150	51	120	*2 see below
-15	SSE 24	dry	-	239	257	-	-	*3 see below
-17	W 8	dry	-	728	250	31	46	*4 see below
-19	SE 5	dry	-	405	255	-	-	
-20	ENE 9	dry	-	193	292	50	84	
-21	S 14	dry	-	968	297	-	-	
-22	W 20	dry	-	1213	274	-	-	
-23	NW 14	dry	-	1030	146	28	49	
-26	S 25	dry(a.m.)	-	212	175	79	-	
-27	S 9	damp(a.m.)	-	124	512	-	-	Charleswood Rd. oiled
-28	W 11	dry	-	181	228	-	-	
-29	W 9	dry	-	237	92	37	61	Repairs on Pepperloaf
-31	WNW 15	dry	-	96	94	-	-	
08-03	Calm <4	dry	-	-	95	-	-	
-04								All samplers removed

UNITS: TSP - micrograms per cubic metre of air as a 24-hour average,
Wind - knots (1 Knot = 1 nautical mile (6000 ft)/hr.)

Comments

1) Elmhurst Rd. oiled, Charleswood Rd. watered, monitoring discontinued at Station C1 on Elmhurst Rd.
2) Construction at the intersection of Rannock and Charleswood.
3) Construction continuing at intersection of Rannock and Charleswood, barriers up and Charleswood Rd. closed to through traffic south of the monitoring site but north of intersection. Barrier in front of 813 Charleswood.
4) Through traffic on Charleswood Rd., Rannock closed between Community and Pepperloaf.

TABLE 2. Total Suspended Particulate (TSP), in Air, Concentrations
Charlewood Area Study

Sampling Date	Prevailing Wind (Dir. MPH)		Visual Road Condition	Sampling Sites C1	C2	C3	7013B	7013P	Comments
83-06-29	SE	13	dry	156	81	-	47	89	
-30	NW	8	wet	23	28	-	-	-	Rain
07-02	ESE	14	wet	33	19	-	13	44	Rain
-05	E	14	damp	169	114	-	28	62	
-06	E	21	damp	99	102	-	-	-	
-07	ESE	12	dry	110	47	-	78	125	
-08	WNW	17	dry	84	112	-	-	-	*1 see below
-11	SW	28	dry	-	381	-	80	108	
-12	S	16	dry	-	490	453	-	-	Start Pepperleaf (C3)
-13	E	13	dry	-	832	485	-	-	
-14	ESE	12	dry	-	144	130	31	120	*2 see below
-15	ESE	24	dry	-	219	292	-	-	*3 see below
-17	W	8	dry	-	128	250	1	46	*4 see below
-19	SE	5	dry	-	405	255	-	-	
-20	ENE	9	dry	-	191	-	50	84	
-21	S	14	dry	-	966	294	-	-	
-22	W	20	dry	-	1113	274	-	-	
-23	NW	14	dry	-	1030	146	28	49	
-26	S	23	dry(a.m.)	-	212	125	19	-	
-27	S	9	damp(a.m.)	-	124	312	-	-	Charlewood Rd. oiled
-28	W	11	dry	-	181	228	-	-	
-29	W	9	dry	-	237	92	37	61	Repairs on Pepperleaf
-31	WNW	13	dry	-	96	94	-	-	
08-02	Calm	<4	dry	-	-	93	-	-	
-04									All samples removed

UNITS: TSP - micrograms per cubic metre of air as a 24-hour average.
Wind - knots (1 Knot = 1 nautical mile (6000 ft)/hr.)

Comments

1) Elmhurst Rd. oiled, Charlewood Rd. watered, monitoring discontinued at Station C1 on Elmhurst Rd.
2) Construction at the intersection of Bancock and Charlewood.
3) Construction continuing at intersection of Bancock and Charlewood, barriers up and Charlewood Rd. closed to through traffic south of the monitoring site but north of intersection. Barrier in front of 813 Charlewood.
4) Through traffic on Charlewood Rd., Bancock closed between Community and Pepperleaf.

TABLE 3. Charleswood TSP Study - Results Summary

Statistic	C1	C2	C3	70118	70119
No. of 24-hour Samples	7	23	16	11	10
Mean Concentration*	78	231	221	43	74
Concentration Range (min.-max.)**	23-169	19-1213	92-512	17-79	46-125
No. of Samples above MAQO, MAL	2	17	13	0	1
Percentage	29%	74%	81%	0	10%
No. of Samples above, MTL	0	9	1	0	0
Percentage	0	39%	6%	0	0

* Geometric Mean TSP ($\mu g/m^3$)

** Range Values are ($\mu g/m^3$)

All concentrations are corrected for STP (Standard Temperature & Pressure) i.e. 25°C and 101.3 Kilopascals.

MAQO = Manitoba Air Quality Objective
MAL = Maximum Acceptable Level
MTL = Maximum Tolerable Level

TABLE 3. Cherrywood TSP Study - Results Summary

Statistic	C1	C2	C3	7DIIB	7DIIS
No. of 24-hour Samples	7	23	16	11	10
Mean Concentration*	78	231	121	63	74
Concentration Range (min.-max.)**	23-169	19-1213	92-312	17-79	46-127
No. of Samples above MAQO, MAL	2	17	13	0	1
Percentage	29%	74%	81%	0	10%
No. of Samples above, MTL	0	9	1	0	0
Percentage	0	39%	6%	0	0

* Geometric Mean TSP ($\mu g/m^3$)
** Range Values are ($\mu g/m^3$)

All concentrations are corrected for STP (Standard Temperature & Pressure) i.e. 25°C and 101.3 Kilopascals.

MAQO - Manitoba Air Quality Objective
MAL - Maximum Acceptable Level
MTL - Maximum Tolerable Level

6. DISCUSSION OF RESULTS

The three sites monitored in Charleswood were selected on the basis of dust complaints and availability of a suitable location. The third site (C3) was established after the cessation of sampling at the first site (C1).

The scope of this monitoring survey was restricted to only the three sites within the Charleswood area. Monitoring at all three sites was eventually terminated as a result of road resurfacing, which ameliorated the dust problem. It was deemed unnecessary to confirm with long term sampling the reduction in TSP levels subsequent to repairs, as the work of others has shown this to be so.[8] During the month of July and early August it appeared that all roads which were the subjects of complaints underwent repairs consisting of grading and the application of seal coating (oil) which suppresses dust.

Levels of TSP at the background stations were consistently below the levels observed in Charleswood on individual days. Lower levels were found at 70118 than 70119, an observation consistent with historical data. The G.M. (43 $\mu g/m^3$) of measurements at 70118, in this study, falls within the range of annual geometric means (32-54 $\mu g/m^3$) calculated over the past 8 years.* The same observation applies to 70119 where the G.M. of this study, 74 $\mu g/m^3$, falls within the range of annual geometric means (56-76 $\mu g/m^3$) calculated over the previous 5 years.

Other historical data is available for comparative purposes. A similar type of project was conducted in 1982 in the McIvor Avenue area of Winnipeg.[4] Citizen concerns resulted in an investigation of air quality, specifically dust levels, along an unpaved portion of McIvor Avenue. The monitoring procedures used were consistent with

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* Historical TSP data for NAPS 70118 and 70119 is summarized in Appendix A.

6. DISCUSSION OF RESULTS

The three sites monitored in Charleswood were selected on the basis of dust complaints and availability of a suitable location. The third site (C3) was established after the cessation of sampling at the first site (C1).

The scope of this monitoring survey was restricted to only the three sites within the Charleswood area. Monitoring at all three sites was eventually terminated as a result of road resurfacing, which ameliorated the dust problem. It was deemed unnecessary to confirm with long term sampling the reduction in TSP levels subsequent to repairs, as the work of others has shown this to be so.* During the month of July and early August it appeared that all roads which were the subjects of complaints underwent repairs consisting of grading and the application of sand coating (oil) which suppresses dust.

Levels of TSP at the background stations were consistently below the levels observed in Charleswood on individual days. Lower levels were found at 7OJ1B than 7OJ1P, an observation consistent with historical data. The G.M. (43 $\mu g/m^3$) of measurements at 7OJ1B, in this study, falls within the range of annual geometric means (32-54 $\mu g/m^3$) calculated over the past 3 years.* The same observation applies to 7OJ1P where the G.M. of this study, 74 $\mu g/m^3$, falls within the range of annual geometric means (58-78 $\mu g/m^3$) calculated over the previous 3 years.

Other historical data is available for comparative purposes. A similar type of project was conducted in 1982 in the McIvor Avenue area of Winnipeg.[8] Citizen concerns resulted in an investigation of air quality, specifically dust levels, along an unpaved portion of McIvor Avenue. The monitoring procedures used were consistent with

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* Historical TSP data for MAPS 7OJ1B and 7OJ1P is summarized in Appendix A.

those in the Charleswood project. The conclusions of the McIvor study were that particulate (dust) levels exceeded the MAQO, 24-hour MAL about 66% of the time. The 24-hour MTL was exceeded approximately 32% of the time. A tabulated summary of the McIvor Avenue project results is listed in Appendix B.

The City of Winnipeg regularly conducts traffic counts at various locations within the city. Traffic counts for locations near the sites used in this study are listed in Appendix C for general information. No attempt was made (or could be made) to correlate traffic volumes to dust levels.

7. SUMMARY AND CONCLUSIONS

Monitoring of total suspended particulate (TSP) levels was conducted within the Charleswood area of the City of Winnipeg during the period June 29 to August 4, 1983. Samples were collected at three different sites located on residential front yards along gravel streets. Sampling was also undertaken concurrently at other urban sites which form part of a National network.

Results from the monitoring indicated:

1) Levels of TSP measured at the background sites were normal with only one measurement (125 $\mu g/m^3$) exceeding the MAL. Since these levels are similar to previously recorded historical data from the same stations, they can be regarded as being representative and indicative of non-elevated concentrations.
2) Prior to road repairs elevated levels of TSP were present in areas of Charleswood where travelled gravel roads were present. The magnitude of these concentrations exceeded the 24-hour MAL the majority of time. The MTL was also exceeded at one site about 40% of the time.
3) Repair of roadways, including the application of oil as a seal coat greatly reduced dust levels. Measurements made at two sites after the application of oil show decreased dust levels.
4) On the basis of two projects conducted by this department and research conducted by other agencies it is evident that elevated dust levels probably exist along gravel roads subject to large volumes of vehicular traffic.

7. SUMMARY AND CONCLUSIONS

Monitoring of total suspended particulate (TSP) levels was conducted within the Charleswood area of the City of Winnipeg during the period June 29 to August 4, 1983. Samples were collected at three different sites located on residential front yards along gravel streets. Sampling was also undertaken concurrently at other urban sites which form part of a National network.

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4) On the basis of two projects conducted by this Department and research conducted by other agencies it is evident that elevated dust levels probably exist along gravel roads subject to large volumes of vehicular traffic.

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APPENDICES

APPENDIX A. (Taken from Ref. #5)
SUMMARY OF URBAN WINNIPEG T.S.P. LEVELS 1970-1982

Station Number	Station Location	1970			1971			1972			1973			1974		
		AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***
9101	411 Broadway (at Kennedy)	79	184	6	73	153	6	75	193	6	78	304	7	77	178	8
9102	2109 Portage (at Woodlawn)	53	131	1	50	132	3	56	172	3	52	318	5	56	186	4
9103	1748 Main (at Hartford)	52	153	2	47	135	2	66	277	6	61	438	7	61	212	4

		1975			1976			1977			1978			1979		
		AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***
9101	411 Broadway (at Kennedy)	69	216	7	81	354	15	73	178	10	-	-	-	-	-	-
9102	2109 Portage (at Woodlawn)	52	157	5	62	204	9	58	163	6	66	193	5	56	392	4
9103	1748 Main (at Hartford)	58	208	8	-	-	-	-	-	-	-	-	-	-	-	-
9118	299 Scotia (at Jefferson)	-	-	-	54	217	6	42	132	2	36	126	1	41	531	5
2011	1350 Pembina Hwy.	-	-	-	-	-	-	-	-	-	64	222	6	66	289	4
9119	65 Ellen St. (Downtown	-	-	-	-	-	-	-	-	-	76	275	11	73	391	10

		1980			1981			1982		
		AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***	AGM*	24-H**	>MAL***
2011	1350 Pembina Hwy.	61	269	9	60	701	5	57	191	6
9102	2109 Portage (at Woodlawn)	67	255	8	57	742	2	52	401	6
9118	299 Scotia (at Jefferson)	34	305	2	40	931	13	32	204	4
9119	65 Ellen St. (Downtown	74	441	16	71	680	56	57	339	25
9120	609 St. Mary's Road	50	415	6	45	452	2	39	176	1

* AGM = Annual Geometric Mean ($\mu g/m^3$) - A geometric mean is calculated because particulate samples are log-normally distributed[3].
** 24-H = Maximum Data Values, 24-hour ($\mu g/m^3$).
*** >MAL = Number of Samples Above 24-hour M.A.L. (24-hour Maximum Acceptable Level = 120 $\mu g/m^3$).
On average approx. 50-60 samples were obtained annually; 9118 = 70118 and 9119 = 70119.

Appendix B.
McIVOR AVENUE PARTICULATE LEVELS
(taken from ref #4)

Sampling Date	Prevailing Wind	Total Suspended Particulates (TSP) Stat. 1 µg/m³	Stat. 2 µg/m³	9118 µg/m³	9119 µg/m³
82-07-10	SE 1	222	222	33	59
82-07-11	W 10	-	395	-	-
82-07-13	NNE 14	57	69	16	33
82-07-14	SE 8	211	184	32	93
82-07-15	S 17	130	36	30	94
82-07-16	S 17	124	102	33	94
82-07-19	S 24	41	24	22	113
82-07-20	N 15	402	444	28	58
82-07-21	N 13	807	673	23	53
82-07-22	ESE 13	600	454	36	138
Geometric Mean		191	163	25	75

	(Sta. 1&2)	(9118 & 9119)
1) No. of samples which exceeded the 24-hour MAL but were less than the MTL* (i.e. 121-400 µg/m³).	7 of 19 (37%)	1 of 19 (5%)
2) No. of samples which exceeded the 24-hour MTL* (i.e. >400 µg/m³).	6 of 19 (32%)	0 of 19

* Please note that the MTL is currently under review.

Appendix B.
MEIVOR AVENUE PARTICULATE LEVELS
(Taken from ref #4)

Sampling Date	Prevailing Wind	Stat. 1 $\mu g/m^3$	Stat. 2 $\mu g/m^3$	9118 $\mu g/m^3$	9119 $\mu g/m^3$
82-07-10	SE 1	272	272	32	39
82-07-11	W 10	-	305	-	-
82-07-13	NNE 14	51	60	16	33
82-07-14	SE 8	321	184	32	93
82-07-15	S 17	130	74	30	94
82-07-16	S 17	124	102	33	84
82-07-19	S 14	41	34	22	113
82-07-20	W 13	402	444	24	78
82-07-21	W 13	307	272	23	73
82-07-22	ESE 13	600	454	34	139
Geometric Mean		191	183	25	71

1) No. of samples which exceeded (Stn. 182) (9118 & 9119)
the 24-hour MAC but were less
than the MTC* (i.e. 121-600
$\mu g/m^3$). 2 of 19 (11%) 1 of 19 (5%)

2) No. of samples which exceeded
the 24-hour MTC* (i.e. >600
$\mu g/m^3$). 0 of 19 (12%) 0 of 19

* Please note that the MTC is currently under review.

APPENDIX C

CITY OF WINNIPEG TRAFFIC COUNTS

Location	Intersection Where Counted	Year	Date	Time Period	Traffic Count
1) Site C1	Elmhurst & Eldridge	1976	Sept. 23	2 hour	262
2) Site C2	Charleswood & Rannock	1976	April 12/13	8 hour	484
			April 12/13	Adj. 12 hour	702
		1978	Aug. 17	7 1/2 hour	293
3) Site C3	Pepperloaf & Roblin	1980	Dec. 10/11	8 hour	662
			Dec. 10/11	Adj. 12 hour	959

Note: 2 Hour, 8 Hour and 7 1/2 Hour figures are actual counts. Adj. 12 hour is 1.45 x 8 hour (the factor of 1.45 is deemed representative by city traffic engineers).